UMD Department of Chemistry & Biochemistry
Spring 2021 Seminar Series
Friday, March 12, 2021
3:30 p.m. Remote via Zoom

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Isolation and Characterization of Novel Hyperthermophilic Manganese (II)-oxidase from Purple Pool Yellowstone National Park

Manganese (Mn) oxides are some of the strongest naturally occurring oxides in nature, playing an important role in geochemical cycling, and living systems. Several theories on the role of Mn in microbial systems exist, but there is not enough supporting evidence to provide a strong argument for these theories. Understanding the role of Mn in microbial systems will allow for further investigations into the evolution of early life, defensive mechanisms, and electron transfer systems in microbes. Preliminary sequence data of biofilms and enrichments of biofilms collected from a Mn-depositing hot spring (102°C) in Yellow Stone National Park (YNP), have yielded findings that suggest a novel hyperthermophilic archaea may be responsible for the accumulation of Mn(III/IV) oxides within the hot spring. There are currently no known hyperthermophilic archaea that is capable of oxidizing Mn(II), an investigation into the properties of the Mn oxidizing properties will have wide impacts in fields of early life, bioremediation, and industry. The investigation will involve biofilm studies, to study its role in Mn oxidation mechanisms, and also in Mn oxide morphologies as a respect of Mn concentration and flow rate. These studies would be useful in biomarker analysis in Mn containing geological features, most notably in YNP. A bioinformatics component of the investigation will involve an investigation of the genome and mapping of possible gene sequences responsible for Mn oxidation. The Mn oxidase genes will then be further contextualized by constructing metabolic pathways of the genomes. The biochemical component will include the isolation and expression, and synthesis of the proteins from the sequenced identified for Mn oxidation. As a protein originating from hyperthermophilic archaea, it is hypothesized that it will have retained activity in high temperatures. These hypothesis will be tested by running activity assays, in respect to product/intermediate formations. In addition, denaturation conditions will be tested to examine the durability of the protein structure. Characterization of the novel Mn oxidation components of the thermophilic archaea will be impactful in fields of environmental science, bioinorganic chemistry, and industry.